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Habitat preferences of European green lizard *Lacerta viridis* (Laurenti 1768) in a protected area, Romania

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Abstract. Anthropic induced changes in land use modify the habitat and microhabitat conditions for many species. Afforestation and grazing abandonment in steppe-like grasslands alters the characteristics of open natural areas. We aim to understand the habitat preferences of the European Green lizard in a nature reserve affected by both processes, using CORINE land cover and data recorded in the field. The results show that the species prefers sparsely shrubbed areas and edge habitat but avoids the interior of the pine plantation and totally open grassland. On microhabitat scale, most preferred structures were shrubs and logs. CORINE Landover data yields statistically less robust information than the microhabitat features recorded in the field Management measures should aim to increase habitat heterogeneity and to decrease compact afforested areas.

Keywords: afforestation, nature protected areas, habitat alteration

Introduction

Habitat destruction, modification and alteration are among the main threats to reptile species around the globe (Doherty *et al.*, 2020; Fitzgerald *et al.*, 2017; Gibbons *et al.,* 2000) and particularly to habitat alteration that results in modification of thermal regime (Nowakowski *et al.*, 2018). Afforestation of grasslands with high natural values, often with non-native trees, represents a major threat for the native biodiversity of the grassland ecosystem (Cao *et al*., 2010; Vassallo *et al*., 2013). The steppe-like grasslands of Eastern Europe have an enormous role as biodiversity reservoirs at local and landscape scales (Ruprecht *et al*., 2009; Rákosy and Kovacs, 2001; Cremene *et al.,* 2005). These ecosystems are under threat not only because of changes in agricultural practices (land conversion in croplands, overgrazing with sheep), but also from alteration due to afforestation e.g. with Austrian pine *Pinus nigra* (Cremene *et al*., 2005). In Romania, and especially in Transylvania, this practice was regarded in the last 50 years as an anti-erosion and equilibration of slopes action (Baciu *et al*., 2010), and even as 'ecological reconstruction' of degraded terrains (Oprea *et al*., 2009), despite the risk of losing plant and invertebrate unique diversity (Cremene *et al*., 2005). Some local populations of European Green lizard *Lacerta viridis* are also locally threatened by such plantations, but also by shrub encroachment resulting from a complete abandonment of farming (Rehák, 2015).

Lacerta viridis (Laurenti, 1768) is a large, thermophile lacertid lizard inhabiting a wide range of habitats: sand dunes, dry areas with shrubs and bushes, steep slopes with rocks and bushes, forest edges and clearings with a certain degree of humidity, road verges or deep river valleys (Covaciu-Marcov *et al*., 2006; Covaciu-Marcov *et al*., 2009; Fuhn and Vancea, 1961; Heltai *et al*., 2015; Rehák, 2015). The green lizard *Lacerta viridis* is widespread in Romania (Cogălniceanu *et al*., 2013) and it is listed as a species of community interest in need of strict protection, with a decreasing population trend (O.U.G. 57/2007; Crnobrnja-Isailović *et al.,* 2009). To ensure a favourable conservation status, active habitat management measures might be needed, which should rely on accurate knowledge of habitat and microhabitat requirements and preferences of the species.

The aim of this study was to understand the habitat use of the green lizard in an arid, steppe-like nature reserve that had been dramatically altered by afforestation and farming abandonment (and subsequent scrub encroachment). We used two approaches to explore the habitat preferences of this lizard: using CORINE land cover data for each transect and by recording the microhabitat features in the field. Our objectives were to identify the habitat and microhabitat preferences of the species and to provide recommendations for research and conservation practice based on our results.

Materials and methods

Study area

Our study area was the Butterfly Hill (Dealul cu fluturi) Nature Reserve (46.527117°N, 23.941970°E), located in the Transylvanian Plain, Romania, 30 km South-East from Cluj-Napoca. It consisted of 20 ha of steep slopes facing south-west, originally covered in dry steppe-like grasslands maintained by extensive grazing. The majority of herbaceous steppic species originated from East European and Southern Russian steppes, but there were several endemic plant species and at least one butterfly species that evolved locally (Rákosy and Kovacs, 2001; Cremene *et al.*, 2005). Over the last 40 years, the area has been afforested with the non-native tree species Austrian pine (*Pinus nigra*) (Cremene *et al.*, 2005). As a result, the nature reserve lost most of its steppe-like character and consisted of a mixture of steppe-like grasslands (*Stipa* sp., *Carex humilis, Festuca rupicola*), pine plantation with snags and logs, and scrubland compose of native (*Prunus spinosa, Crataegus monogyna, Cornus sanguinea*) and introduced (*Hippophae rhamnoides, Eleagnus angustifolia*) species (Rákosy and Kovacs, 2001).

Field survey and data collection

The field survey took place over a period of three months, starting with the onset of the reproductive season, between April and June 2019.

Data was gathered from 20 sampling units (5 x 100 m), randomly selected from a total of 64 units, separated by 20 m distance, covering the entire area of the nature reserve. The sampling area covered 10.000 m^2, representing 5% of the total area. All selected sampling units were surveyed monthly, during a single day, resulting in three visits per unit. The surveys were done by line transects of 100 m length and a 2.5 m width on each side to be visually inspected for the presence of the species at walking speed in a constant pace. Surveys were carried out in good, sunny weather, without rain or wind, between 07.00 a.m. and 14 p.m. We recorded the gender and age of every observed individual, as well as the microhabitat feature where each animal was spotted. Each sampling unit was assessed regarding habitat characteristics. We used two types of habitat variables to classify the sampling units. First, transect variables based on Corinne Land Cover system (area of shrubland, grassland, (pine) forest plantation and habitat diversity based on Shannon entropy). Variables like insolation and slope were initially also considered but later removed from modelling to keep the explanatory variables low related to the number of transects (20). Univariate analysis showed no influence of insolation and slope on lizard abundance. Second, microhabitat variables were collected in the field while walking along each transect, in order to characterize the surroundings of each observed lizard. Variables recorded represented the full spectra of microhabitats available in the points where lizard occurred, such as: the presence of living shrubs, dead shrubs, pine plantation edge, fallen trees, and tall grass. The representation of habitats and microhabitats captured by our variables is visible in Figure 1.

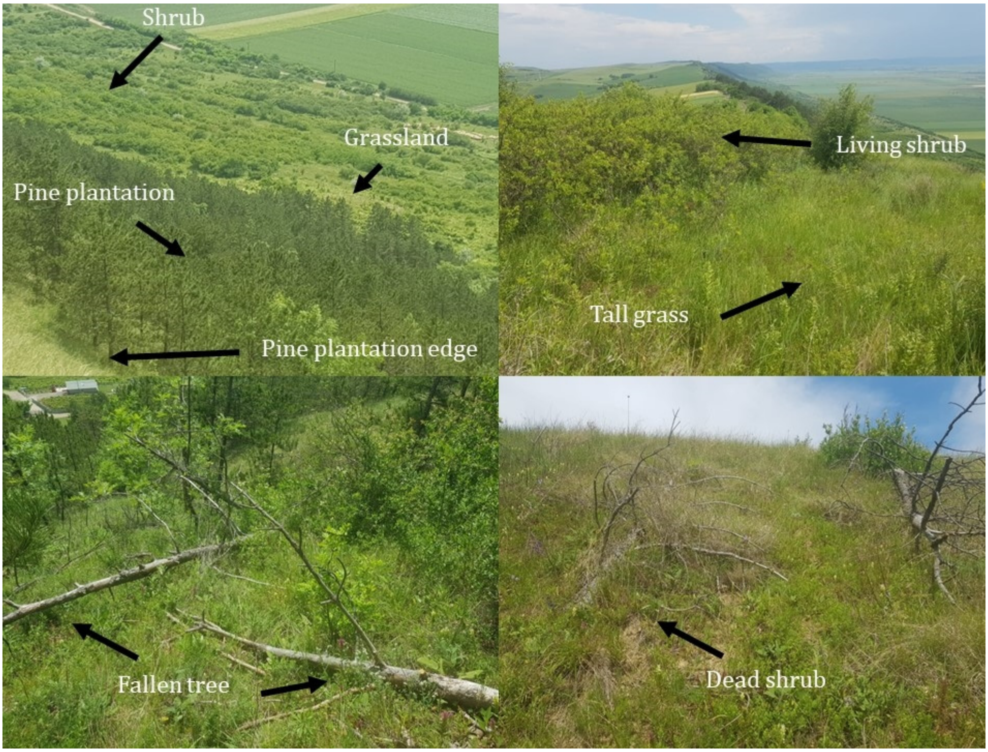

Figure 1. Diversity of habitats and microhabitats analysed in "Dealul cu fluturi" Nature Reserve

Data analysis

The statistical analysis was performed at two levels, according to the two approaches (see above) by implementing habitat use models and descriptive statistics. Before applying the habitat use models and presenting the descriptive statistics, we explored the detection probability of the lizards using occupancy models. The detection probability (p) shows the probability of detecting the organism in a site given that the organism is present. The detection probability can also be used to assess the number of site visits to infer the species absence (with 95% confidence) through the formula:

N_{min}=log(0.05) / log(1-p), where N_{min} is the minimum number of surveys per site and p is the detection probability (Pellet & Schmidt, 2005).

To model the relationship between the number of lizards and the transect characteristics, we used the following variables: grassland, shrub, pine plantation, slope and isolation. We excluded the survey month from the analysis because and initial check showed that it has no effect on the number of lizards detected (Kruskal-Wallis test, P = 0.22). The values of the transect variables were *log* transformed and standardised (average of 0, SD of 1). We tested for the collinearity between the transect variables and found no correlation between the independent variables.

To model the abundance *L. viridis* we used the information theoretic model selection approach based on Akaike information criterion (AIC) (Tab. 1).

Table 1. Model description

Variable (s)	Hypothesis
Grassland+Shrub+Pine forest+Habitat diversity	Green lizard abundance is determined by multiple transect variables
Grassland	Green lizard abundance along transects is determined by the proportion of grassland along the transect. Open areas are feeding habitats.
Shrub	The proportion of shrub along the transect is important. Shrubby areas are shelters against predators and excessive sun.
Pine plantation	The proportion of pine plantation along the transect negatively affects lizard abundance. Pine is a suboptimal habitat for *L. viridis* because it creates moist and shady microhabitat.
Habitat diversity (Shannon)	The habitat diversity along the transect positively influences green lizard abundance.
Null model	None of the recorded variables is important for green lizard abundance along the transects.

We used percentage values to visualize the distribution of individuals detected in the field in different types of microhabitats (this being the descriptive part of our analysis).

Statistical analyses were performed in R (with bbmle and AICcmodavg packages) and Excel.

Results

Detection probability

During the 3 surveys we observed the species 66 times. We detected 28 European Green Lizard individuals in April, 14 in May and 24 in June. The naïve estimate of the occurrence in the transects was 0.85 while the estimate based on occupancy model was 0.87 (SE=0.08). The detection probability was high (p = 0.70). The number of visits to infer absence with 95% confidence was 2.48, showing that three surveys per transect were enough for this species in the study area. We did not find any relationship between the CORINE variables (Tab. 1) and the detection probability of this lizard (data not showed).

Abundance modelling according to transect variables (CORINE data)

The habitat modelling shows that the best models explaining the green lizard abundance along the transects were the 'Shrub' and 'Grassland' models followed by the 'Pine plantation' model (Tab. 2). The model coefficients show positive relationship between lizard abundance and shrub proportion (estimate ± SE = 0.23 ± 0.16) and grassland proportion (estimate ± SE = 0.25 ± 0.19) along the transect and a negative relationship with pine plantation (estimate ± SE = -0.14 ± 0.16). While the model results have sense based on the expert knowledge related to the ecology of lizards (see below), from a statistical perspective the habitat models cannot be distinguished from the null model.

Table 2. Results of the model selection for the abundance of *L. viridis*. The model coefficients (estimate and SE) for the first three variables are presented in the text.

Model variables	**AICc**	***Δ*AICc**	**AIC*wt***	**Cum.*wt***
Null model	88.33	0.00	0.28	0.28
Shrub	88.65	0.31	0.24	0.53
Grassland	88.98	0.64	0.20	0.74
Pine plantation	89.98	1.64	0.12	0.87
Habitat diversity	90.16	1.82	0.11	0.98
Full model	94.64	6.30	0.01	1.00

Microhabitat preference based on field data

Out of 66 detections of *L. viridis*, the vast majority (70%) of observations were related to living shrubs (38%), the pine plantation's edge (32%), fallen pine trees (14%), dead shrub (12%) and tall grassland (4%) (Fig. 2).

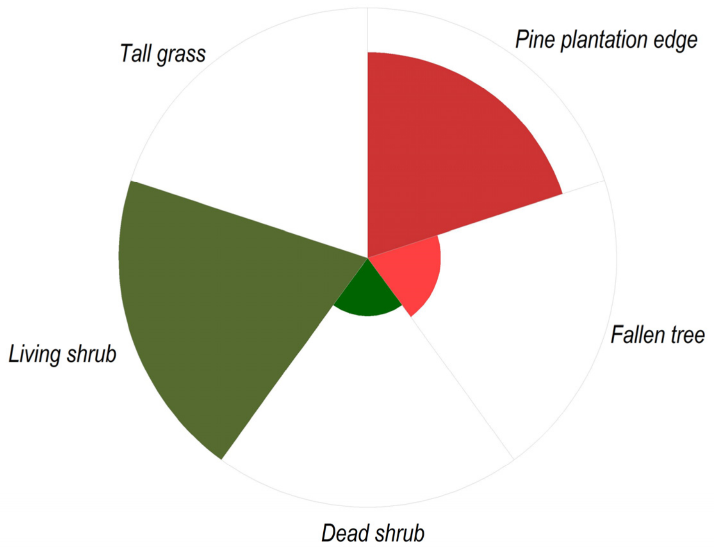

Figure 2. The proportion of green lizards recorded in habitat types. Min-max normalized values are presented, where the habitat with lowest proportion of lizards (Tall grass) is 0 and the habitat with the highest proportion of lizards (Living shrub) is 1. See text for proportion values.

Discussions

Our results show that the detectability of the green lizards in the studied area is high, and the sampling effort was adequate to detect these organisms. We showed that the abundance of the green lizards was highest in locations with living shrubs and pine plantation edge, and it was lowest in the tall grass. Furthermore, we show that the transect method as employed in this study combined with CORINE Landover data yields statistically less robust information (albeit ecologically interpretable) than the microhabitat features recorded in the field. The explanation may be that in very small scale the CORINE data have limited precision and/or the transect method is not suitable for the available CORINE landcover types of data at small scales.

The availability of thermally suitable microhabitats is one of the key parameters characterizing the habitat quality for lizards, but not the only one, food availability and predation pressure being also important, perhaps even more than the structural features of the habitat (Díaz, 1997). All three parameters might be reduced to habitat features on which they depend, like shelter and increased invertebrate diversity in shrubland (Walker *et al.*, 2014) that serve as food source. Thermoregulation implies moving between sun and shade (Huey, 1974), and our results show that the two most important habitat variables are the presence of shrubs and trees in combination with grassland on a small scale, thus providing a mosaic of different ecological conditions. Our results confirm other findings that heterogeneous areas with bushy parts are most suitable for the species (Heltai *et al*., 2015; Prieto-Ramirez *et al*., 2018, 2020a). The results regarding microhabitat use show that shrubs and logs the most used features by lizards for basking and as shelter and/or hiding place, confirming other observations for the European Green lizard (Heltai *et al*., 2015), but also for related species *L. bilineata* (Luppi *et al*., 2020). Although statistically not robust result, the modelling approach resulted in negative estimate regarding the proportion of pine plantation along the transect and lizard abundance. The pine plantation interior is compact, shaded, and cold, and these conditions are far from optimal for the green lizard. However, the edge of the plantation is almost as important as the presence of shrubs. Linear structures and edges availability in the patches are very important conservation measures for the species (Prieto-Ramirez *et al*., 2020). Our results show that within the nature reserve, areas with compact pine plantation does not constitute favourable habitat for the European Green Lizard. Plantations of exotic tree species have a negative effect, resulting in increased rarity of other poikilotherms species like *Salamandra salamandra* or *Rana dalmatina,* coniferous plantations being the least important areas for herpetofauna (Covaciu-Marcov *et al*., 2009). Coniferous plantations are utilised by reptile species in early successional stages, but not in mature plantations, with well-developed canopy cover (Jofré *et al*., 2016). Strong shading, as in pine plantations, has a negative effect on invertebrates' diversity and abundance (Cremene *et al.,* 2005; Corfey *et al.,* 2018; Cifuentes-Croquevielle *et al*., 2020) and invertebrates represents the food of this species (Mollov *et al*., 2012; Maier *et al.,* 2020). We show that the green lizard abundance is low in tall grass without any structural elements (trees, shrubs). Structural features such as the woody vegetation benefits the green lizard in several ways (see above) while the compact tall grass may limit its movement and habitat options, highlighting the importance of extensive management.

In the successional stages which are characterized by shrub and tree dominance resulting from the abandonment of the traditional management only few species of butterflies reach their maximum abundance (Cremene *et al.*, 2005), and the distribution of lizard species is restricted by the lack of appropriate sun basking sites (Huey, 1974). Pine plantations in former natural oak forests are also associated with modification in lizard species assembly, with the loss of *Timon lepidus* (Amo *et al*., 2007), a species that prefers open and dry areas of woodland and scrubland.

Despite their longevity and exceptional biodiversity (Feurdean *et al*., 2015), in the last decades, steppe-like grasslands were considered either unproductive or less profitable than other types of land use, so afforestation was practiced on a large scale, including in protected areas (Resmeriță *et al.,* 1968; Cremene *et al*., 2005), profoundly altering the habitat of many species. Management actions should be guided by habitat and microhabitat preferences of the species, and it is also important to protect the habitat surrounding the patches where the species is present, at a scale of 250m (Prieto-Ramirez *et al*., 2020).

Conclusions

Anthropic induced changes in land use in nature protected areas modify the habitat and microhabitat features that are essential for the persistence of European Green lizard. The short-term abandonment of grazing benefits the species by increasing the habitat heterogeneity through the installation of native shrub species that provide appropriate basking and shelter conditions. Afforestation also creates favourable habitat by providing ecotonal condition on the edge of the plantation, but the interior of the plantation is avoided by the species. In areas already afforested, the elimination of some pine trees to create patchy areas with grassland and shrub would greatly improve the habitat quality.

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References

Amo, L., López, P., & Martín, J. (2007). Natural oak forest vs. ancient pine plantations: Lizard microhabitat use may explain the effects of ancient reforestations on distribution and conservation of Iberian lizards. *Biodiversity and Conservation*, 16, 3409–3422. https://doi.org/10.1007/s10531-006-9003-3

Baciu, N., Stănescu, C., Muntean, O.-L., Mihăiescu, R., & Mihăiescu, T. (2010). Geo-systems and types of geo-facets in the Transylvanian Plain-tools for defining cultural landscapes. *Present Environment and Sustainable Development*, 4, 255–261.

Cao, S., Tian, T., Chen, L., Dong, X., Yu, X., & Wang, G. (2010). Damage Caused to the Environment by Reforestation Policies in Arid and Semi-Arid Areas of China. *AMBIO*, 39, 279–283. https://doi.org/10.1007/s13280-010-0038-z

Cifuentes-Croquevielle, C., Stanton, D. E., & Armesto, J. J. (2020). Soil invertebrate diversity loss and functional changes in temperate forest soils replaced by exotic pine plantations. *Scientific Reports*, 10(7762), 1–11. https://doi.org/10.1038/s41598-020-64453-y

Cogălniceanu, D., Rozylowicz, L., Székely, P., Samoilă, C., Stănescu, F., Tudor, M., Székely, D., & Iosif, R. (2013). Diversity and distribution of reptiles in Romania. *ZooKeys*, 341, 49–76. https://doi.org/10.3897/zookeys.341.5502

Corley, J., Dimarco, R., Fischbein, D., Lantschner, M., Martínez, A., Masciocchi, M., Mattiacci, A., Paritsis, J. & Villacide, J. (2018). A synthesis on the impact of non-native conifer plantations on ant and beetle diversity in north-western Patagonia, *Southern Forests*: *a journal of Forest Science,* 80(4), 285-291. DOI:10.2989/20702620.2018.1432536

Covaciu-Marcov, S.-D., Cicort-Lucaciu, A.-Ștefan, Dobre, F., Ferenți, S., Birceanu, M., Mihuț, R., & Strugariu, A. (2009). The herpetofauna of the Jiului Gorge National Park, Romania. *North-Western Journal of Zoology*, *5*(1), 501–578.

Covaciu-Marcov, S.-D., Ghira, I., Cicort-Lucaciu, A.-Ş., Sas, I., Strugariu, A., & Bogdan, H. (2006). Contributions to knowledge regarding the geographical distribution of the herpetofauna of Dobrudja, Romania. *North-Western Journal of Zoology*, 2(2), 88–125.

Cremene, C., Groza, G., Rakosy, L., Schileyko, A. A., Baur, A., Erhardt, A., & Baur, B. (2005). Alterations of steppe-like grasslands in Eastern Europe: A threat to regional biodiversity hotspots. *Conservation Biology*, 19(5), 1606–1618. https://doi.org/10.1111/J.1523-1739.2005.00084.X

Crnobrnja-Isailović, J., Vogrin, M., Corti, C., Mellado, V. P., Sá-Sousa, P., Cheylan, M., Pleguezuelos, J., Nettmann, H.K., Sterijovski, B., Lymberakis, P., Podloucky, R., Cogalniceanu, D., & Avci, A. (2009). *Lacerta viridis*. The IUCN Red List of Threatened Species e.T61530A12507156. http://dx.doi.org/10.2305/IUCN.UK.2009.RLTS.T61530A12507156.en

Díaz, J. A. (1997). Ecological correlates of the thermal quality of an ectotherm's habitat: A comparison between two temperate lizard populations. *Functional Ecology*, 11(1), 79–89. https://doi.org/10.1046/j.1365-2435.1997.00058.x

Doherty, T. S., Balouch, S., Bell, K., Burns, T. J., Feldman, A., Fist, C., Garvey, T. F., Jessop, T. S., Meiri, S., & Driscoll, D. A. (2020). Reptile responses to anthropogenic habitat modification: A global meta-analysis. *Global Ecology and Biogeography*, 29(7), 1265–1279. https://doi.org/10.1111/geb.13091

Feurdean, A., Marinova, E., Nielsen, A. B., Liakka, J., Veres, D., Hutchinson, S. M., Braun, M., Timar-Gabor, A., Astalos, C., Mosburgger, V., & Hickler, T. (2015). Origin of the forest steppe and exceptional grassland diversity in Transylvania (central-eastern Europe). *Journal of Biogeography*, 42(5), 951–963. https://doi.org/10.1111/jbi.12468

Fitzgerald, L. A., Walkup, D., Chyn, K., Buchholtz, E., Angeli, N., & Parker, M. (2017). The future for reptiles: Advances and challenges in the anthropocene. *Encycl. Anthropocene* 3, 163–174. Inc. https://doi.org/10.1016/B978-0-12-809665-9.10291-5

Fuhn, I. E., & Vancea, Ş. (1961). Fauna Republicii Populare Romîne, Vol XIV, fascicula 2, Reptilia (in Romanian). *Ed. Acad. R.P.R.*, Bucureşti, 352 pp.

Gibbons, J. W., Scott, D. E., Ryan, T. J., Buhlmann, K. A., Tuberville, T. D., Metts, B. S., Greene, J. L., Mills, T., Leiden, Y., Poppy, S., & Winne, C. T. (2000). The Global Decline of Reptiles, Déjà Vu Amphibians. *BioScience*, 50(8), 653-666. https://doi.org/10.1641/0006-3568(2000)050[0653:tgdord]2.0.co;2

Heltai, B., Sály, P., Kovács, D., & Kiss, I. (2015). Niche segregation of sand lizard (Lacerta agilis) and green lizard (Lacerta viridis) in an urban semi-natural habitat. *Amphibia Reptilia*, 36(4), 389–399. https://doi.org/10.1163/15685381-00003018

Huey, R. B. (1974). Behavioral thermoregulation in lizards: Importance of associated costs. *Science*, 184(4140), 1001–1003. https://doi.org/10.1126/science.184.4140.1001

Jofré, G. M., Warn, M. R., & Reading, C. J. (2016). The role of managed coniferous forest in the conservation of reptiles. *Forest Ecology and Management*, 362, 69–78. https://doi.org/10.1016/j.foreco.2015.11.044

Luppi, M., Gentilli, A., & Bogliani, G. (2020). Microhabitat selection of the Western green lizard Lacerta bilineata. *Natural History Sciences. Atti Soc. It. Sci. Nat. Museo Civ. Stor. Nat. Milano*, 7(2), 3–10. https://doi.org/10.4081/nhs.2020.451

Maier, A.-R.-M., Cadar., A.-M., & Covaciu-Marcov, S.-D. (2020). Last meal: food composition of road-killed Lacerta viridis (Reptilia: Lacertidae) from Romania. *Stud. Univ. Babeş-Bolyai Biologia*, 65(1), 49-60. doi:10.24193/subbbiol.2020.1.05

Mollov, I., Boyadzhiev, P., & Donev, A. (2012). Trophic Niche Breadth and Niche Overlap Between Two Lacertid Lizards (Reptilia: Lacertidae) from South Bulgaria. *Acta Zool Bulgar*, Suppl. 4, 133-140

Nowakowski, A. J., Watling, J. I., Thompson, M. E., Brusch, G. A., Catenazzi, A., Whitfield, S. M., Kurz, D. J., Suárez-Mayorga, Á., Aponte-Gutiérrez, A., Donnelly, M. A., & Todd, B. D. (2018). Thermal biology mediates responses of amphibians and reptiles to habitat modification. *Ecology Letters*, 21(3), 345–355. https://doi.org/10.1111/ele.12901

Oprea, V., Blaga, Gh., Păcurar, I. & Kovacs, E. (2009). The Ecological Reconstruction of the Degraded Terrains from the Transylvanian Hill area through the Cultivation of the Silvo-Ameliorative Shrubs. *Bulletin UASVM Agriculture*, 66 (1), 576-579.

O.U.G. 57/2007. Ordonanţa de urgenţă nr. 57/2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei şi faunei sălbatice (Emergency Ordinance no. 57/2007 on the regime of protected natural areas, conservation of natural habitats, wild flora and fauna). Bucharest. [In Romanian]

Pellet, J., & Schmidt, B. R. (2005). Monitoring distributions using call surveys: estimating site occupancy, detection probabilities and inferring absence. *Biological Conservation*, 123(1), 27–35. https://doi.org/10.1016/J.BIOCON.2004.10.005

Prieto-Ramirez, A. M., Pe'er, G., Rödder, D., & Henle, K. (2018). Realized niche and microhabitat selection of the eastern green lizard (*Lacerta viridis*) at the core and periphery of its distribution range. *Ecology and Evolution*, 8(22), 11322–11336. https://doi.org/10.1002/ece3.4612

Prieto-Ramirez, A. M., Röhler, L., Cord, A. F., Pe'er, G., Rödder, D., & Henle, K. (2020a). Differential effects of habitat loss on occupancy patterns of the eastern green lizard Lacerta viridis at the core and periphery of its distribution range. *PLoS ONE*, 15(3), 1-24. https://doi.org/10.1371/JOURNAL.PONE.0229600

Rákosy, L., & Kovacs, S. Eds. (2001). The Nature Reserve "Butterfly hill" in Viișoara. Societatea Lepidopterologică Romana, Cluj-Napoca, Romania (in Romanian). 138 pp.

Rehák, I. (2015). Protecting and managing a local population of the European Green lizard Lacerta viridis at the Prague Zoo, Czech Republic. *Int. Zoo Yb*. 49: 56–66 DOI:10.1111/izy.12093

Resmeriţă, I., Csűrös, I. & Spîrchez, Z. (1968). Vegetaţia, ecologia şi potenţialul productiv pe versanţii din Podişul Transilvaniei (Vegetation, ecology and production potential on hillslopes of the Transylvanian Basin) [in Romanian]. *Ed. Academiei R.S.R.,* Bucureşti, Romania, 206 pp.

Ruprecht, E., Szabó, A., Enyedi, M. & Dengeler, J. (2009). Steppe-like grasslands in Transylvania (Romania): characterisation and influence of management on species diversity and composition. *Tuexenia* 29: 353–368.

Vassallo, M. M., Dieguez, H. D., Garbulsky, M. F., Jobbágy, E. G., & Paruelo, J. M. (2013). Grassland afforestation impact on primary productivity: A remote sensing approach. *Applied Vegetation Science*, 16(3), 390–403. https://doi.org/10.1111/avsc.12016

Walker, S., Wilson, D. J., Norbury, G., Monks, A., & Tanentzap, A. J. (2014). Effects of secondary shrublands on bird, lizard and invertebrate faunas in a dryland landscape. *New Zealand Journal of Ecology*, 38(2), 242-256.